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IMPROVING COMMUNICATION OF DESIGN TARGET REQUIREMENTS TO FACILITATED ENHANCED CRAFTSMANSHIP DELIVERY

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Introduction

To deliver craftsmanship in the premium automotive industry it is essential to have a clear process for the communication and setting of targets within the supply base. This research has determined the key areas in which craftsmanship delivery is failing in the premium automotive sector in the UK. The ongoing collaboration with premium vehicle manufacturers and the supply chain has promoted a dynamic, action based approach to this research. This has involved ongoing active participation with the market analysts, design engineers, manufacturing engineers working on the vehicle development programme at the early stages of the New Product Introduction (NPI) process. This research has detailed that the areas of target communication, market attribute understanding and supplier target agreements are the main areas of disconnection in the process used on past programmes. From this basis the implementation of a process to aid the realisation of craftsmanship requirements in the final vehicle is discussed.

Background

The processes used to develop new vehicles in the automotive industry are well developed, with every auto manufacturer having a New Product Introduction (NPI) process in place to achieve the successful manufacture of desirable end products [1]. The aims of the Original Equipment Manufacturer (OEM) can be realised at the concept stage of NPI provided the initial research accurately reflects the final customer wants [2]. This requires the means to accurately translate marketing determined customer requirements into engineering design targets for the supporting functions [3].

The premium automotive sector represents the cutting edge of technology and luxury [4] and to compete in this sector vehicle manufacturers have to set themselves apart from their competitors [2]. To establish the vehicle attributes that are deemed important to the consumer the upfront research carried out by marketing has to cover, in detail, the various attributes of the vehicle including driving dynamics, styling and craftsmanship. From this market research the primary differentiators can then be established. The information gathered at this stage of the vehicle development process is then translated into a set of engineering design targets that are fed into the engineering development cycle of the NPI process. These targets are subsequently communicated to the selected suppliers as quantified engineering targets. The reasons behind focussing on the vehicle attribute of ‘craftsmanship’ is as a result of additional research carried out at the International Automotive Research Centre (IARC), which has

determined that ‘craftsmanship’ is a primary differentiator between vehicles in the premium automotive sector [5].

Premium automotive research collaboration

As part of Warwick Manufacturing Group (WMG), the IARC was founded on 2nd April 2003 with £72 million of the UK regional development agency Advantage West Midlands (AWM) and industrial funding to concentrate on supporting the manufacture of high value premium products, a key sector for the future of UK engineering [6]. Through the Premium Automotive Research and Development (PARD) programme work is currently being undertaken, in collaboration with local premium vehicle manufacturers, which analyses the ability of current development processes to generate high quality engineering targets – for the ‘craftsmanship’ attribute - linked directly to real world customer requirements. This ‘action based’ research analyses the methods used to translate these targets throughout the various phases of the NPI process, particularly from the qualitative marketing information into the quantitative requirements of the engineering function. The aim of the research is to provide a means for the system suppliers to an auto OEM to incorporate improved craftsmanship elements into their product.

The links in place between the IARC and its collaborators allow the dynamic application of any new ideas generated from the action based research directly into the development process of a new vehicle as it happens. This allows the ideas to be assessed as the programme unfolds which in turn allows for their real time adaptation as required.

Scope of involvement

The three functions of the vehicle development process that were analysed as part of this research are –

- Market research – This function establishes the customer based requirements for the vehicle, emphasising the importance of each vehicle attribute in relation to the customer through targets based on the required marketing placement of the vehicle in relation to its competitors.

- Engineering development – This function covers the engineering development of the vehicle as a whole within the OEM, this includes the engineering departments of design, development, manufacturing etc. The engineering development function is responsible for translating the marketing targets into quantifiable engineering targets which will be used to produce the final vehicle.

- Supplier development – This function covers the role of the supplier in their development of the initial targets into a final vehicle system (i.e. seats). It also covers the role the suppliers play in helping to specify the vehicle targets based on their ability to achieve the initial requirements.

Research methodology

Research objective: -

Improve the communication of design target requirements from a vehicle manufacturer to their component/system suppliers throughout an NPI process with the aim of enhancing overall final vehicle 'craftsmanship' perception.

Case Studies

In order to identify the areas in a NPI process that are the most likely cause of process disconnection two detailed case studies have been carried out on the vehicle development programmes for new Jaguar XJ series and the Land Rover Discovery 3, launched in 2003 and 2004 respectively. These case studies have analysed the ability of automotive manufacturers to exhibit a high perceived level of 'craftsmanship' in their final vehicles using the same base NPI process. This provided an opportunity to analyse the success these companies have had at delivering a desirable end product whilst utilising the same development process.

The development process used by the OEM was also analysed in an attempt to assess its suitability toward the vehicle development objectives of a premium automotive manufacturer. In the case of the larger automotive OEM's the emphasis of their NPI process would be to produce vehicles in large volumes at a desirable standard, generally for the mass-market consumer [4]. As opposed to a premium manufacturer whose objective would be to incorporate premium levels of attribute satisfaction in relatively low volumes. The results of this analysis feed into the development of solutions that can help to eliminate the problems highlighted in the case studies.

Customer Surveys

In order to determine the desires of the target customer, regarding the opinions they hold on craftsmanship, a set of craftsmanship specific questions have been included in the 2004 Top Gear vehicle satisfaction survey. The data gathered for this survey accounted for 48,000 verified respondents within the UK market. Consumer satisfaction surveys carried out on the automotive sector provide a vital insight into the consumer perception of vehicle attributes by assessing the levels of satisfaction inspired by the various aspects of their car. To achieve this, a section of questioning aimed specifically at craftsmanship covering the sensory perception of quality was added to the survey questionnaire. The final questions were tested to assess their clarity from a layman's perspective [7], and the integrity that could be expected from the final results. This is the first time a set of questions based around the vehicle attribute of 'craftsmanship' has been included in a major vehicle satisfaction survey in the UK. The final data that was generated from the survey has been made available in 2005 and used for correlation against other existing customer satisfaction data such as J D Power and in-house customer satisfaction assessments carried out by the vehicle manufacturers. This highlights the benefits and limitations of each method for generating reliable customer vehicle satisfaction data on which research direction focus can be based.

Action based research with collaborators

The collaboration effort between the IARC Jaguar cars, Land Rover (JLR) and vehicle system suppliers has provided a direct means of assessment of the suitability and success of the ongoing research. The work is being applied, at the concept stage, to a current vehicle

development programme with the full backing of the senior JLR management. This has allowed the early integration of a revised approach to communication based on the initial research and a direct link between academia and industry which promotes the active sharing of ideas.

Initial Results

Analysis of the case studies has resulted in the development of a set of conceptual models that represent both past and future communication approaches that can be seen in figures 1 & 2. The methods taken to carry out the research was based around the realisation of a process of vehicle development which replicates, in practice, the approach portrayed in the diagrams.

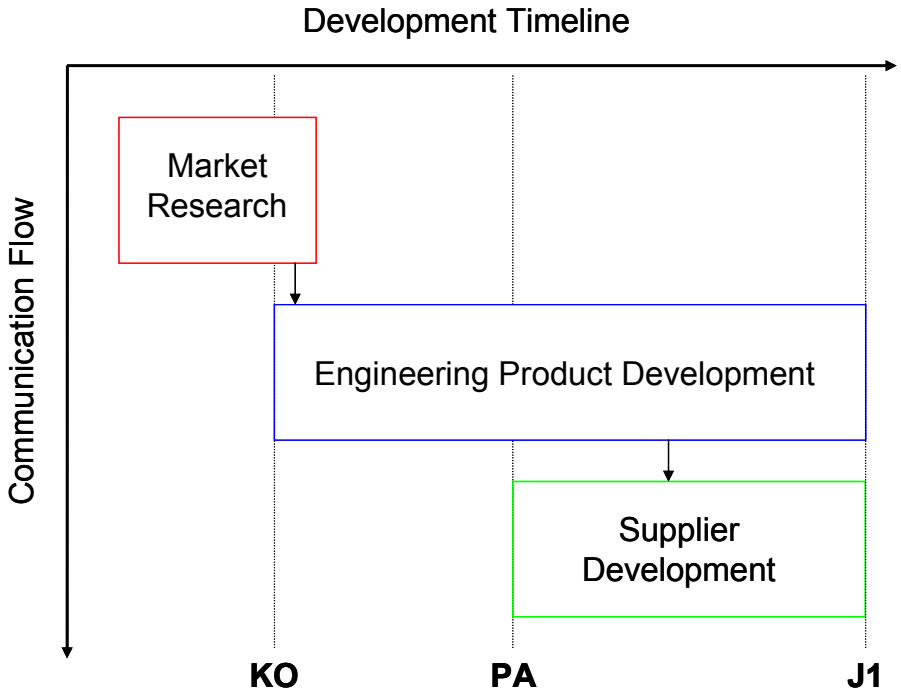

Figure 1.Conceptual model of sequential target communication used on the case study development programmes

Figure 1 illustrates a stepped approach to the communication flow for the vehicle development process which has been employed by one of the collaborative manufacturers. Research has shown that the sequential nature of this process limits the communication between the three areas which restricts the ability to disseminate knowledge throughout the three areas of development. An example of this is when the market research function develops a complete set of preliminary targets independently before handing them over to the engineering function, from that point they no longer have input into the target setting process. A problem with this approach to target setting is that the next function in the sequence then has to interpret the targets based on their understanding of the attribute area. The initial research has shown that a lack of supplier involvement in the up front vehicle development has a substantial impact on desired attribute targets. Research has also highlighted that the general consumer's opinion on attribute areas such as craftsmanship differs greatly to that of an engineer [8], which can lead to a scenario where vehicle requirements deemed important to the consumer and the future success of the product, but not necessarily to the engineer, being

compromised. Ultimately this can result in a final product that fails to meet its base requirements yet achieves the engineering targets set for it. This approach to vehicle development can result in a scenario where an initial target specifying a competitor leadership target for an attribute is compromised through its translation. As the target is cascaded through the NPI process each function lowers the target resulting in an uncompetitive attribute score in the final product.

From the research it has been highlighted that this early target setting phase of development is critical to the successful delivery of craftsmanship. This research finding has led to the formulation of a revised approach to target setting communication as shown in figure 2. This diagram highlights the involvement of each of the three departments during the development process and illustrates the phase in which the implementation of the results of this research will be applied. The diagram displays the scope of knowledge required by each function (y axis) against the development timeline. The scope of knowledge represents the level of detail each department has regarding the total vehicle from 'technical' quantitative data to the 'marketing' qualitative data. The diagram was developed based on the preliminary research and represents a foreseen 'ideal' communication and awareness process for the three functions.

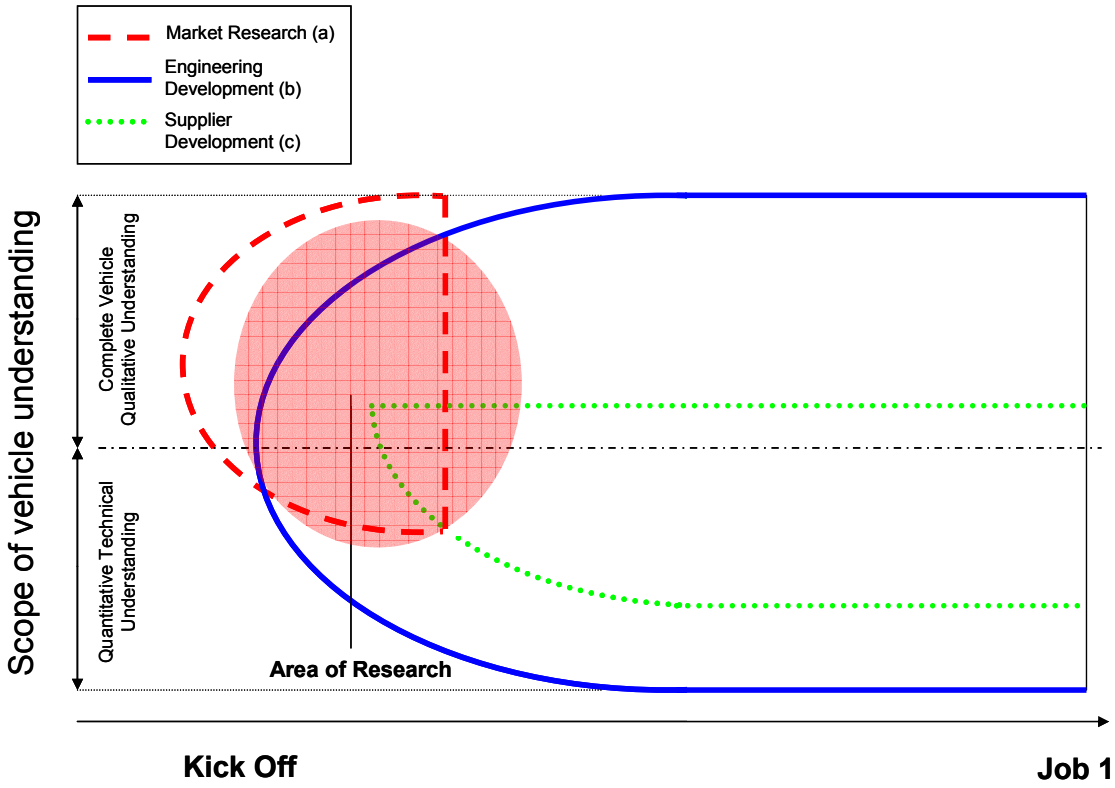

Figure 2. Conceptual 'ideal' communication and knowledge overlap for vehicle development functions

In the case of premium vehicle development marketing need a broader understanding of the total vehicle requirements than the supplier. The supplier is mainly, though not solely, concerned with the engineering requirements of their system and any interfacing systems but not the whole vehicle. The market research understanding of the vehicle does not include the level of technical detail engineering development requires but does encompass the whole vehicle. Their involvement with the target setting process also takes place at the very front end of the development programme.

Engineering development has the most complete understanding of the total vehicle as they require a technical and general understanding of the complete vehicle assembly and the interfacing of each vehicle system. Their involvement with the development runs through the complete NPI process (and beyond). The supplier has the narrowest scope of understanding with regards the total vehicle, being concerned primarily with the system they are developing (e.g. seats) and its interfacing systems. But their involvement with the vehicle development runs through to the completion of the vehicle development in conjunction with engineering.

As opposed to the stepped approach to target communication the approach illustrated in figure 2. incorporates an overlap for the development involvement of the three functions. This represents the sharing of knowledge to aid the setting of vehicle targets that reflect the consumer desires. The highlighted area, encompassing the communication overlap between the three functions, represents the current level of collaborative involvement being carried out for this research. As discussed earlier the research is 'action based' and as such is being actively pursued on a current premium vehicle development programme. This also means that the timing of the research is tied directly with the timing of the development programme which is currently scheduled for completion in 2007.

Case study output

The case studies carried out as part of this research identified a number of areas of potential disconnection in the process for delivering vehicle craftsmanship. Two disconnects identified as key to the process, form the basis for the direction of the research being carried out-

1. The procedure used for communicating the initial, market set, vehicle design requirements is not referred to after their initial use right at the very beginning of the development. The method by which these initial marketing targets are delivered does not provide a sufficient level of background knowledge or detail to truly represent the customer's voice.

2. The engineering target agreements set for the suppliers were not clear in their definition of attributes such as craftsmanship and there is no definition of the terminology used to describe the commitments that the supply base is to make.

Customer research findings

The findings of the extensive UK based customer research carried out, concerning consumer attitudes toward vehicle craftsmanship, provided a unique insight into the role of this attribute within the premium automotive sector. The primary findings of this research based around the premium automotive sector in the UK were: -

1. Craftsmanship is a key differentiator and success factor within the premium automotive sector for the UK market. The survey results highlight a direct link between high levels of craftsmanship and competitive performance with success for craftsmanship helping to instil brand loyalty for future purchases.

2. The selection of materials used within vehicle interiors has the greatest impact on the overall level of craftsmanship perceived by the customer for the specific vehicles analysed as part of the survey.

Process incorporated into current NPI process

The process proposed to aid the implementation of craftsmanship can be seen in figure 3. This simple process diagram illustrates the communication of the craftsmanship requirements through the development process from consumer craftsmanship research to the final product. The boxes titled market research, engineering development & supplier development represent the development systems for each stage of the process of setting target requirements. The output for each system becomes the input for the next in the sequence with feedback loops introduced to maintain adherence to the original customer requirements. The illustration demonstrates the process in a sequential manner with each step clearly separated. In reality the process would follow a sequence more in line with that illustrated in figure 2 which demonstrates a development overlap to aid the sharing of knowledge by all parties involved with the development. The final output of this target development process ultimately leads to a final product that will accurately represent the customer's desires.

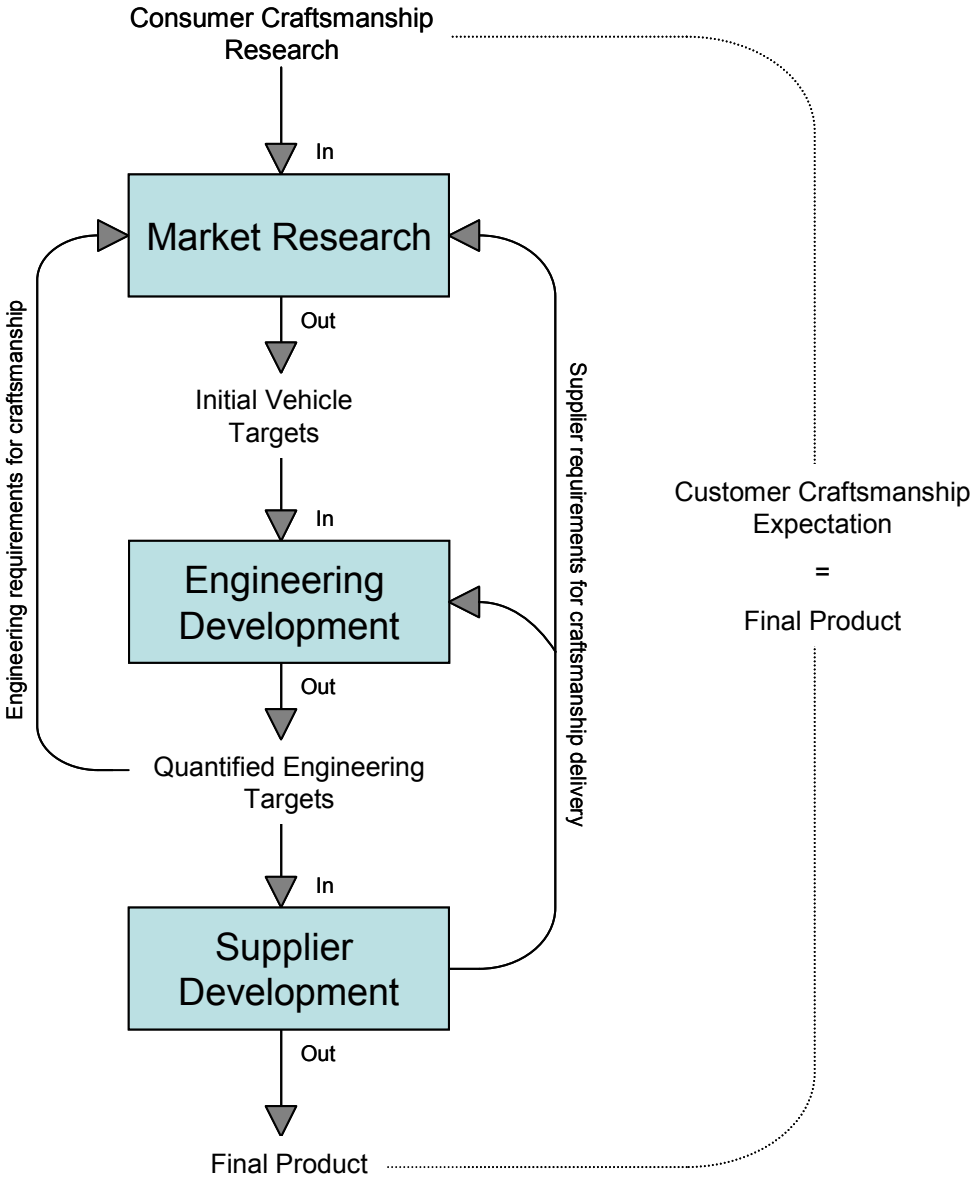

Figure 3. Conceptual 'ideal' process communication and target flow leading to the final vehicle

Discussion

The initial results have provided a focus for the future research direction, highlighting the requirement for the establishment of an understanding of the craftsmanship attribute at the very start of the development process. This has also provided a focus on five areas of the current upfront vehicle development process that have to be developed to aid the delivery of craftsmanship targets reflective of the original customer desires. These five areas are as follows: -

Bridge Disconnects

Based on the results of the case studies gaps at the front end have to be bridged and the communications loops and understanding have to be firmly established for the marketing and engineering functions. The understanding the marketing function has of the key engineering attributes has to be developed to aid the setting of targets for the vehicle development. The attribute area of 'craftsmanship' has to be understood in its base form [6] which includes each aspect identified as making up the general understanding of vehicle craftsmanship. By developing this understanding of craftsmanship at the very beginning of a vehicle development programme quality targets that will be referred to throughout the vehicle development can be established. Through the research it has become apparent that existing techniques such as Quality Function Deployment (QFD) [9] can be used to aid the incorporation of craftsmanship - from the customer's perspective - into the engineering targets.

Early supplier communication

Dialogue with suppliers has to be established early in the sourcing phase, putting the requirements for craftsmanship delivery up front in the initial supplier sourcing documentation.

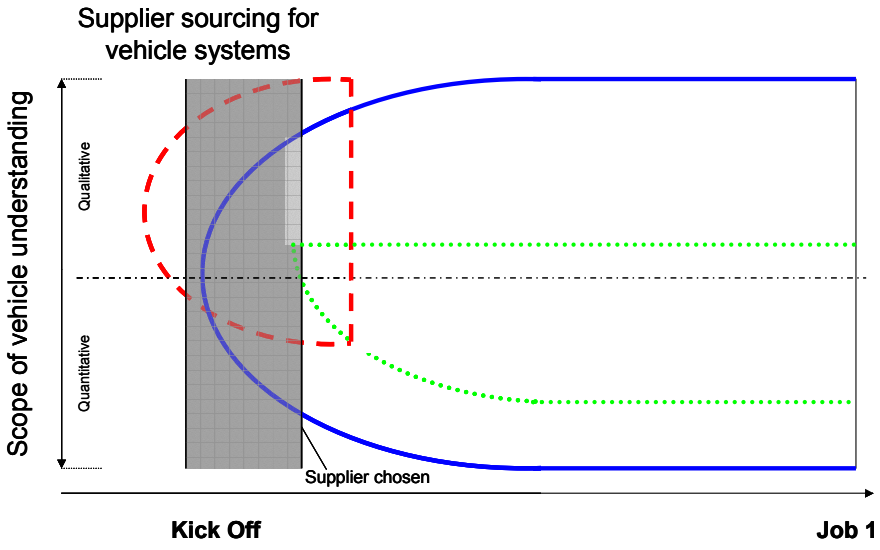

Figure 4. Supplier sourcing phase

To promote the understanding and importance of craftsmanship, within the premium automotive manufacturing sector to the supply base, the relevance of craftsmanship has to be emphasised in any early sourcing documentation compiled by the automotive OEM. By

raising the awareness of this attribute at this early stage of selection the supplier can implement the requirements specific to their system needed for delivering craftsmanship. The initial research has shown that initiating early dialogue avoids assumptions on attribute understanding and promotes the generation of sourcing documentation that is transparent and understandable.

Methods of communication

The method used to communicate the initial marketing set targets have to be clear and understandable to the parties that are to interpret them. The form in which the targets are communicated to the vehicle development functions has to provide enough detail to afford a high level of understanding – of the targets - for the parties required to act upon them. The methods currently employed for translating this marketing data do not provide a means for explanation of the targets for each individual attribute. Rather there is a generic understanding of the targets which then gets applied to the specific areas. By communicating the targets in an accessible format unnecessary confusion surrounding the initial requirements is avoided.

Craftsmanship Understanding

The designation of the responsibility of craftsmanship delivery and understanding has to be clarified through improved communication flow between the parties involved in vehicle development. The research has shown that the marketing, engineering and supplier functions have to improve the current communication of craftsmanship responsibility. This can be visualised in figure 2. The function overlaps in this diagram represent areas in the development process where the three parties have to be involved in active communication. As can be seen this communication between all three parties takes place at the front end of the process. By actively pursuing working dialogue between parties the requirements for craftsmanship delivery are clarified.

Target Setting

Target setting for engineering product development has to be based on actual design manufacture capabilities. By establishing good communication and assignation of responsibilities between OEM and supplier the targets developed at the start of the vehicle programme can be established to reflect the actual manufacturing capabilities available. This up front knowledge reduces the number of iterations required to develop obtainable engineering targets that reflect the consumer requirements. This also raises the awareness of the benefits to be had from utilising the expertise of the suppliers early on to assess the achievability of the target requirements.

Future research

The nature of the research dictates that the assessment of the process integration cannot be carried out until the product has been on the market long enough to generate adequate levels of customer feedback. Leading up to the final assessment the work that has to be carried out as part of this ongoing research is as follows:-

- Target agreements to cover craftsmanship thoroughly

- Formulate a process based around the initial results that will enable the future implementation of craftsmanship requirements.

Conclusions

The preliminary case studies highlighted two areas of disconnection in the delivery of craftsmanship in the final vehicle, target communication and the supplier target agreement documentation. By facilitating the integration of an early sourcing strategy that establishes specific craftsmanship requirements for the suppliers the awareness of craftsmanship is raised. Through working with suppliers at this early stage of vehicle development and increasing the awareness of the craftsmanship attributes relevance to overall vehicle satisfaction; the ability of the supplier to meet any target requirements set for this attribute area can be improved.

Incorporating a set of craftsmanship questions into a major satisfaction survey has generated an understanding of craftsmanship in the context of the premium automotive industry. This knowledge can be used to focus future vehicle development for improved craftsmanship delivery, from the customer's perspective, in the final product.

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